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0CAN051301

May 16, 2013

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

SUBJECT: Generic Letter 2004-02 Closure Option
Arkansas Nuclear One – Units 1 and 2
Docket Nos. 50-313 and 50-368
License Nos. DPR-51 and NPF-6

REFERENCES:
1. Entergy letter to NRC, *Generic Letter (GL) 2004-02 Revision to the Final Supplemental Response and Requests for Additional Information (RAIs)*, dated September 29, 2010 (0CAN091001)
2. Entergy letter to NRC, *GL 2004-02 Supplemental Information*, dated April 8, 2010 (0CAN041001)
3. NRC letter to Entergy, *GL 2004-02 Supplemental Response*, dated January 26, 2010 (0CNA011002) (ML100190320)
4. Entergy letter to NRC, *GL 2004-02 Final Supplemental Response RAI*, dated September 24, 2009 (0CAN090901)
5. Entergy letter to NRC, *GL 2004-02 Final Supplemental Response*, dated September 15, 2008 (0CAN090801)

Dear Sir or Madam:

In accordance with References 1 and 2 Entergy Operations, Inc. (Entergy) provided supplemental information to the NRC concerning GL 2004-02 for Arkansas Nuclear One (ANO). Reference 3 documents the acceptable NRC review of References 4 and 5. Based on Reference 3 Entergy's remaining open issue for closure of GL 2004-02 is the successful resolution of "in-vessel" effects.

On July 9, 2012, the NRC issued SECY 12-0093 which provided recommendations for closure options for Generic Safety Issue-191. Based on industry testing, the bounding "in-vessel" fiber limits are extremely restrictive. Entergy has selected Option 2 and intends to pursue refinements to evaluation methods and acceptance criteria. To support use of this path and continued operation for the period required to complete the necessary analysis and testing, Entergy has evaluated the design and procedural capabilities that exist to identify and mitigate in-vessel blockage. A description of these detection and mitigative measures are provided in Attachment 1. Additionally, a summary of the existing margins and conservatisms that exist for ANO are also included in Attachment 1.

This letter contains new regulatory commitments, which are identified in Attachment 2. Should you have any questions concerning the content of this letter, please contact Stephenie Pyle at 479.858.4704.

I declare under penalty of perjury that the foregoing is true and correct. Executed on May 16, 2013.

Sincerely,

Original signed by Jeremy G. Browning

JGB/nbm

Attachments: 1. GL 2004-02 Closure Option
2. List of Regulatory Commitments

cc: Mr. Arthur T. Howell
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NRC Senior Resident Inspector
Arkansas Nuclear One
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U. S. Nuclear Regulatory Commission
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Attachment 1 to

0CAN051301

Generic Letter (GL) 2004-02 Closure Option

GL 2004-02 Closure Option

Introduction

On July 9, 2012, the NRC staff issued SECY-12-0093, "Closure Options for Generic Safety Issue (GSI)-191, Assessment of Debris Accumulation on Pressurized-Water Reactor Sump Performance," presenting three closure options to the Commission all of which are considered to be viable paths for resolving GSI-191. These options are: Option 1 – "Compliance with 10 CFR 50.46 Based on Approved Models," Option 2 – "Mitigate Measures and Alternate Methods Approach (Deterministic or Risk-Informed)," and Option 3 – "Different Regulatory Treatment for Suction Strainer and In-Vessel Effects (Deterministic or Risk-Informed)." On December 14, 2012, the Commission approved the staff's recommendation to allow licensees to choose any of the three closure options.

Entergy Operations, Inc. (Entergy) has selected Option 2a utilizing a deterministic methodology for both strainer and in-vessel effects for both Arkansas Nuclear One Unit 1 (ANO-1) and Unit 2 (ANO-2). The deterministic resolution of strainer effects has been fully documented in previous submittals to the NRC. References 1 and 2 provided supplemental information to the NRC concerning GL 2004-02, and Reference 3 documents the acceptable NRC review of References 4 and 5. The deterministic resolution of the in-vessel effects is being accomplished in accordance with the resolution strategy proposed by the Pressurized Water Reactor Owners Group (PWROG) as discussed below.

In order to support continued operation for the time period required to complete the necessary analyses, testing and plant modifications (if necessary), Entergy has evaluated the design and procedural capabilities that exist to prevent, detect, and mitigate sump strainer and in-vessel blockage for ANO-1 and ANO-2. A summary of these prevention, detection, and mitigative measures are provided later in this submittal.

Characterization of Current Containment Fiber Status

From the debris generation and debris transport analysis, Entergy has determined that approximately 110 pounds (lbs) and 106 lbs for ANO-1 and ANO-2, respectively, of fibrous debris could be transported to the strainer from a loss-of-coolant accident (LOCA) as documented in Reference 1, Attachments 1 and 2, Sections 3.b.4 and Section 3.f.5, respectively. These amounts (design values) include the maximum amount of non-latent fibrous material generated by the bounding break from a LOCA and transported to the strainer (79.9 lbs from Reference 1, Attachment 1, Table 3.b.4-1 for ANO-1 and 75.3 lbs from Reference 1, Attachment 2, Table 3.f.5-1 for ANO-2) and a bounding latent fiber load of 30 lbs transported to the strainer. In Reference 1 the actual (lower) latent fiber loads measured at the time of the submittal were provided. A latent fiber loading of 30 lbs has been established as bounding (15% of 200 lbs).

Entergy previously performed strainer bypass testing for ANO-2 in 2006 and determined that the bypass mass fraction was substantially less than 5%. As such, 5% bypass was used in the downstream analysis. The bypass testing used grab sampling techniques to calculate bypassed mass fraction after each debris addition. Based on information provided at industry workshops, testing must be based on full-flow capture of the bypassed debris.

Entergy plans to follow the PWROG efforts to establish acceptable limits for in-vessel debris and intends to perform bypass testing using Reference 6 in order to confirm the adequacy of the existing downstream analysis. The results of this testing establish the quantity of fiber that is expected to be transported to the reactor fuel.

The fibrous debris sources considered in these analyses include the following fibrous insulation types:

- Temp Mat (ANO-1)
- High Density Fiberglass (ANO-1)
- Transco Thermal Wrap (ANO-1 and ANO-2)
- Cera Fiber (ANO-1 and ANO-2)
- Penetration Blanket Fiber (ANO-1)
- Latent Fiber (ANO-1 and ANO-2)

Also from Reference 1, Attachments 1 and 2, Sections 3.c.4 and 3.e.1, the analysis assumes transport of all fiber fines but not transport or erosion of the 40% large pieces of Temp-Mat and Thermal-Wrap fiber that remain trapped inside their fabric covers.

Characterization of Strainer Head Loss Status

Entergy previously provided the results of strainer head loss testing, including the impact of chemical effects, in References 1, 4, and 5. The results of this testing demonstrate acceptable results with regard to allowable head loss.

Characterization of In-Vessel Effects

Entergy intends to follow the resolution strategy proposed by the PWROG for establishing in-vessel debris limits for the type of plant design that exists at ANO-1 and ANO-2.

Licensing Basis Commitments

Entergy currently has a commitment from Reference 4 to provide the NRC with a formal response to requests for additional information (RAIs) associated with in-vessel effects within 90 days of issuance of the final NRC Safety Evaluation on WCAP-16793. As a result of the remaining open issues associated with GL 2004-02 for ANO and the information contained within this submittal, the previously established commitments are considered to be closed based on the intended direction to be taken as described in this submittal. New commitments as a result of this submittal are described in Attachment 2.

Resolution Schedule

Entergy, although the ANO units are not high fiber plants, has elected as a path for resolution Option 2a. ANO's current fiber bypass testing utilized an older protocol for fiber bypass testing. Entergy will achieve closure of GSI-191 and address GL 2004-02 per the following schedule:

- Complete bypass re-testing and incorporate results into ANO calculations as necessary by December 15, 2014

- Follow PWROG in-vessel testing projects and incorporate results into ANO calculations as appropriate:
    - "Addressing Boric Acid Precipitation to Support GSI-191 Closure and Evaluation Model Development" (testing is expected to be completed in February 2014, with WCAP issued in June 2014)
    - "Comprehensive Analysis and Test Program for GSI-191 Closure" (testing is expected to be completed in February 2014, with WCAP issued in May 2014)

- Complete the necessary insulation replacements, remediation, or model refinements within three refueling outages of January 1, 2013 (1R26 currently scheduled for the Spring 2016 and 2R25 Spring 2017 for ANO-1 and ANO-2, respectively)

- Within six months of establishing a final determination of the scope of insulation replacement or remediation, or model refinements, Entergy will submit a final updated supplemental response to support closure of GL 2004-02 for ANO-1 and ANO-2. Entergy expects to submit the final updated supplemental response by June 30, 2015.

- Entergy will update the current licensing basis (ANO-1 and ANO-2 Safety Analysis Reports) following NRC acceptance of the final updated supplemental response for ANO-1 and ANO-2 and completion of the identified removal or modification of insulation debris sources in containment.

Summary of Actions Completed To Address GL 2004-02

To support closure of GSI-191 and to address GL 2004-02, Entergy has completed the following actions for ANO-1 and ANO-2 which are documented in References 1, 2, 4, and 5):

ANO-1:

- Replaced strainers with an engineered modular design that has a filtering surface area of 2715 ft^2 with 1/16" screen openings (specifically Reference 5, Attachment 1, Section 3.j.1)
- Fibrous insulation removal and calcium-silicate insulation banding
- Latent debris sampling and characterization, including other debris sources, e.g., labels, etc.
- Generated and revised debris generation analyses based on walkdown information
- Strainer head loss testing
- Ex-vessel downstream effects analysis
- Post-accident buffer pH reduction
- Net positive suction head analysis
- Programmatic and procedural changes established to maintain acceptable configuration and protect the newly established design and licensing basis (Containment Closeout, Coatings, and Housekeeping procedures; Upper Level Document development)

ANO-2:

- Replaced strainers with an engineered modular design that has a filtering surface area of 4837 ft^2, with 1/16" screen openings (specifically Reference 5, Attachment 2, Section 3.j.1)
- Buffer change from Tri-Sodium Phosphate to Sodium Tetraborate
- Fibrous insulation removal and calcium-silicate insulation banding
- Latent debris sampling and characterization, including other debris sources, e.g., labels, etc.
- Generated and revised debris generation analyses based on walkdown information
- Strainer head loss testing
- Ex-vessel downstream effects analysis
- Net positive suction head analysis
- Calcium-silicate erosion, transport, and dissolution testing
- Refueling canal drain strainers installed
- Programmatic and procedural changes established to maintain acceptable configuration and protect the newly established design and licensing basis (Containment Closeout, Coatings, and Housekeeping procedures; Upper Level Document development)

Summary of Margins and Conservatisms for Completed Actions for GL 2004-02

The following provides a summary description of the margins and conservatisms associated with the resolution actions taken to date. These margins and conservatisms provide support for the extension of time required to address GL 2004-02 for ANO-1 and ANO-2.

- Debris Generation – Each debris type was compared to its tested surrogate to determine the margin available and documented in a sump margins report. Surveys show that the latent debris loadings are considerably below the 200-pound allocation (15% or 30 lbs of this limit is fiber). The following debris generation analysis assumptions conservatively maximized the quantity of debris generated for LOCAs which then maximizes the head losses across the strainer, thereby minimizing net positive suction head (NPSH), structural, and flow margins:
    - Spherical zone-of-influence (ZOI) method employed
    - Combination of break locations to maximize debris generation
    - Unqualified coatings fail
    - Additional coatings margin included in the downstream analyses

- Debris Transport – Entergy has conservatively assumed that 100% of the fiber fines generated in the ZOI transports to the strainer, and no credit is taken for settling of fiber. The following debris transport analysis assumptions provided conservative values for transport of debris to the sump in excess of quantities that would be generated:
    - Debris hold-up not credited
    - Flow barriers not credited
    - Debris settling not credited
- Strainer Head Loss – The two-train flow NPSH margins vary from 3.77 feet (ft) to 5.64 ft for the ANO-1 reactor building spray and the low-pressure injection pumps, respectively, and from 1.67 ft to 7.06 ft for the ANO-2 high-pressure safety injection and containment spray pumps, respectively. In addition, minimum containment water levels were utilized for NPSH analysis. The NPSH analyses maximized the debris loads and pump flow rates through the strainers, while minimizing the sump water level available. These conservatisms ensure margin during plant recirculation operations. The debris head loss is applied immediately.
- Chemical Effects – The chemical effects margins can be equated to the amount of thick aluminum surface area evaluated in containment versus the equivalent surface area of aluminum present during chemical effects testing. A margin of greater than 1400 ft^2 of thick aluminum exists for ANO-1, and a margin of more than 1600 ft^2 exists for ANO-2. The test protocol used for strainer head loss testing was specifically designed to attain a ‘thin bed’ layer of debris that compacts tightly and produces the maximum head loss. The thin bed effect is achieved by assuming that debris and chemical products arrive at the sump strainer in very precise rations and in a specific order. It is highly unlikely that debris that transports to the sump strainers would arrive in such an order. In addition, the protocol assumes that chemical precipitants form at the elevated temperatures of the design-basis large-break LOCA (LBLOCA). Chemical precipitants do not readily form in solution at LBLOCA onset temperatures.
- Emergency Core Cooling System (ECCS) Flow – NPSH calculations are performed for design-basis ECCS flows. Cases have been run for ANO-2 to validate that adequate NPSH exists for the failure of a low-pressure safety injection pump to trip upon establishing recirculation.
- In-vessel – A number of margins exist in the generic 15 gram (g)/fuel assembly (FA) limit identified by WCAP-16793, Revision 2. These include temperature (viscosity) effects of actual post-LOCA conditions versus test conditions, flowrates assumed in testing versus actual flowrates in the core, particulate-to-fiber ratios used during testing that are lower than normally assumed in latent debris surveys, and a number of other issues identified in PWROG-OG-12-287, dated July 20, 2012. Entergy is participating in industry testing to raise the 15 g/FA limit.

Summary of Defense-In-Depth Measures

The following describes the plant-specific design features and procedural capabilities that exist for detecting and mitigating a strainer blockage or fuel blockage condition.

Strainer Blockage

ANO-1 and ANO-2 have within their Emergency Operating Procedure (EOP) framework, specific steps for monitoring for indications of sump strainer blockage and actions to be taken if this condition occurs. These actions are described in the Entergy's response to NRC Bulletin 2003-01, *Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized-Water Reactors*, dated August 7, 2003 (0CAN080302), and the subsequent response to the NRC RAIs dated June 10, 2004 (0CAN060402), and August 31, 2005 (0CAN080502). The actions taken in response to the bulletin remain in effect at ANO-1 and ANO-2.

Fuel (Core) Blockage

- Detection

  Multiple methods exist for detection of a core blockage condition as manifested by an inadequate reactor coolant system (RCS) inventory or RCS and core heat removal condition. The primary methods include core exit thermocouples and reactor vessel level monitoring system. This monitoring is initiated early in the event in the EOPs through the safety function status checks which are performed at least every 15 minutes throughout the event. An additional method for detection of a core blockage condition includes monitoring of containment radiation levels and/or if an alarm setpoint is reached resulting in an alarm in the control room.

- Mitigation

  Upon identification of an inadequate RCS inventory or core heat removal condition, the EOPs/Severe Accident Management Guidelines direct the operators to take actions to restore cooling flow to the RCS including:

  - Securing high pressure injection for ANO-1 when low pressure injection meets minimum flow and reducing high pressure safety injection flow for ANO-2
  - Refilling the ANO-1 borated water storage tank (BWST) and ANO-2 refueling water tank (RWT)
  - Attempting to provide core cooling by steaming through the steam generators
  - Filling the RCS from alternate paths

The operators may also perform the following actions, as necessary, to restore core heat removal:

- Inject water into the RCS through the auxiliary spray lines
- Reduce RCS injection flow rate to meet minimal heat removal requirements
- Makeup to the BWST/RWT from various plant water sources using a fire hose connection
- Consideration of the use of the unaffected unit's water supplies
- Restart reactor coolant pumps (ANO-2 only)
- Flood containment using a portable pump

Although these measures are not expected to be required based on the very low probability of an event that would challenge either the capability of the strainer to provide the necessary flow to the ECCS and reactor building/containment spray system, or result in significant quantities of debris being transported to the reactor vessel that would inhibit the necessary cooling of the fuel, they do provide additional assurance that the health and safety of the public would be maintained. These measures provide support for the extension of time required to completely address GL 2004-02 for ANO-1 and ANO-2.

Conclusion

Entergy expects that the GSI-191 resolution path for ANO-1 and ANO-2 is acceptable based on the information provided in this submittal. The execution of the actions identified in this submittal results in successful resolution of GSI-191 and closure of GL 2004-02.

References

1. Entergy letter to NRC, *GL 2004-02 Revision to the Final Supplemental Response and RAIs*, dated September 29, 2010 (0CAN091001)

2. Entergy letter to NRC, *GL 2004-02 Supplemental Information*, dated April 8, 2010 (0CAN041001)

3. NRC letter to Entergy, *GL 2004-02 Supplemental Response*, dated January 26, 2010 (0CNA011002) (ML100190320)

4. Entergy letter to NRC, *GL 2004-02 Final Supplemental Response RAI*, dated September 24, 2009 (0CAN090901)

5. Entergy letter to NRC, *GL 2004-02 Final Supplemental Response*, dated September 15, 2008 (0CAN090801)

6. Nuclear Energy Institute Generic Guideline for Strainer Fiber Bypass Test Protocol (Draft) dated December 7, 2011

Attachment 2 to

0CAN101205

List of Regulatory Commitments

List of Regulatory Commitments

The following table identifies those actions committed to by Entergy in this document. Any other statements in this submittal are provided for information purposes and are not considered to be regulatory commitments.

COMMITMENT	TYPE (Check One)		SCHEDULED COMPLETION DATE (If Required)
	ONE-TIME ACTION	CONTINUING COMPLIANCE	
Complete bypass re-testing and incorporate results into Arkansas Nuclear One (ANO) calculations	X		December 15, 2014
Participate in Pressurized Water Reactor Owners Group in-vessel testing projects and incorporate results into ANO calculations as appropriate	X		Ongoing
Complete the necessary insulation replacements, remediation, or model refinements	X		1R26 Spring 2016 2R25 Spring 2017
Within six months of establishing a final determination of the scope of insulation replacement or remediation, or model refinements, Entergy will submit a final updated supplemental response to support closure of GL 2004-02 for ANO-1 and ANO-2.	X		June 30, 2015
Entergy will update the current licensing basis (ANO-1 and ANO-2 Safety Analysis Reports).	X		Following NRC acceptance of the updated supplemental response for ANO-1 and ANO-2 and completion of the identified removal or modification of insulation debris sources in containment